

Inpatient Hyperglycemia - Adult

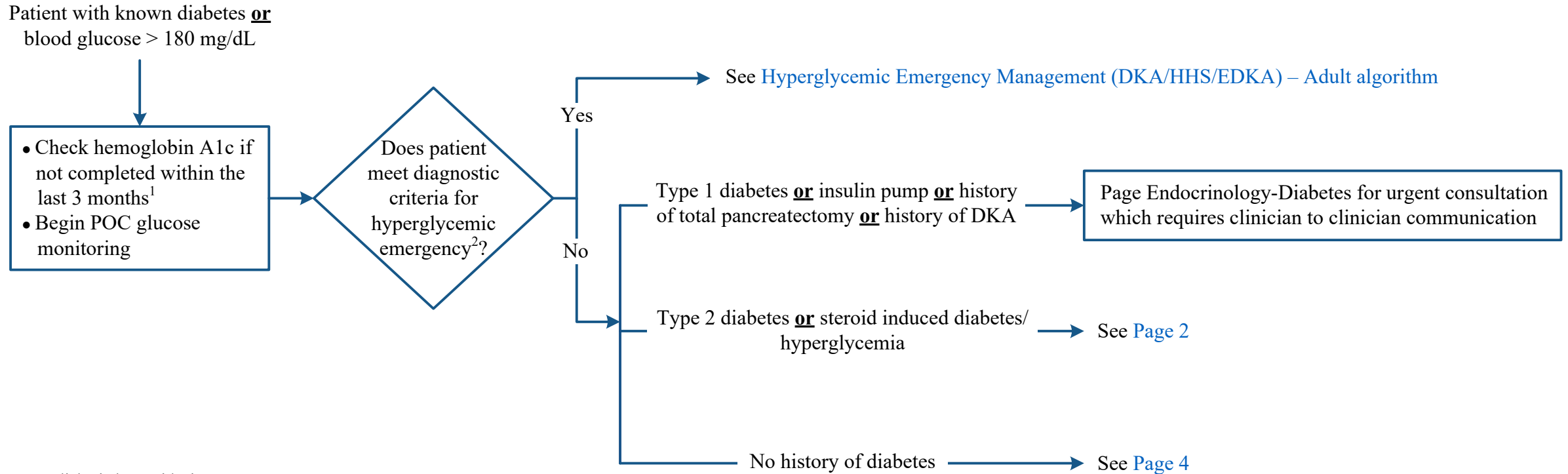
Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson's specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.

Note: Insulin dose adjustments should be made based on the individual patient's glucoses. Refer to the [Hypoglycemia Management algorithm](#), as indicated.

PRESENTATION

INITIAL EVALUATION

TREATMENT



DKA = diabetic ketoacidosis
 EDKA = euglycemic diabetic ketoacidosis
 HHS = hyperosmolar hyperglycemic state
 POC = point of care

¹ Hemoglobin A1c may be inaccurate if recent blood transfusion within the past three months or severe anemia

² Diagnostic criteria:

DKA: blood glucose > 250 mg/dL and arterial pH < 7.3 **or** bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia

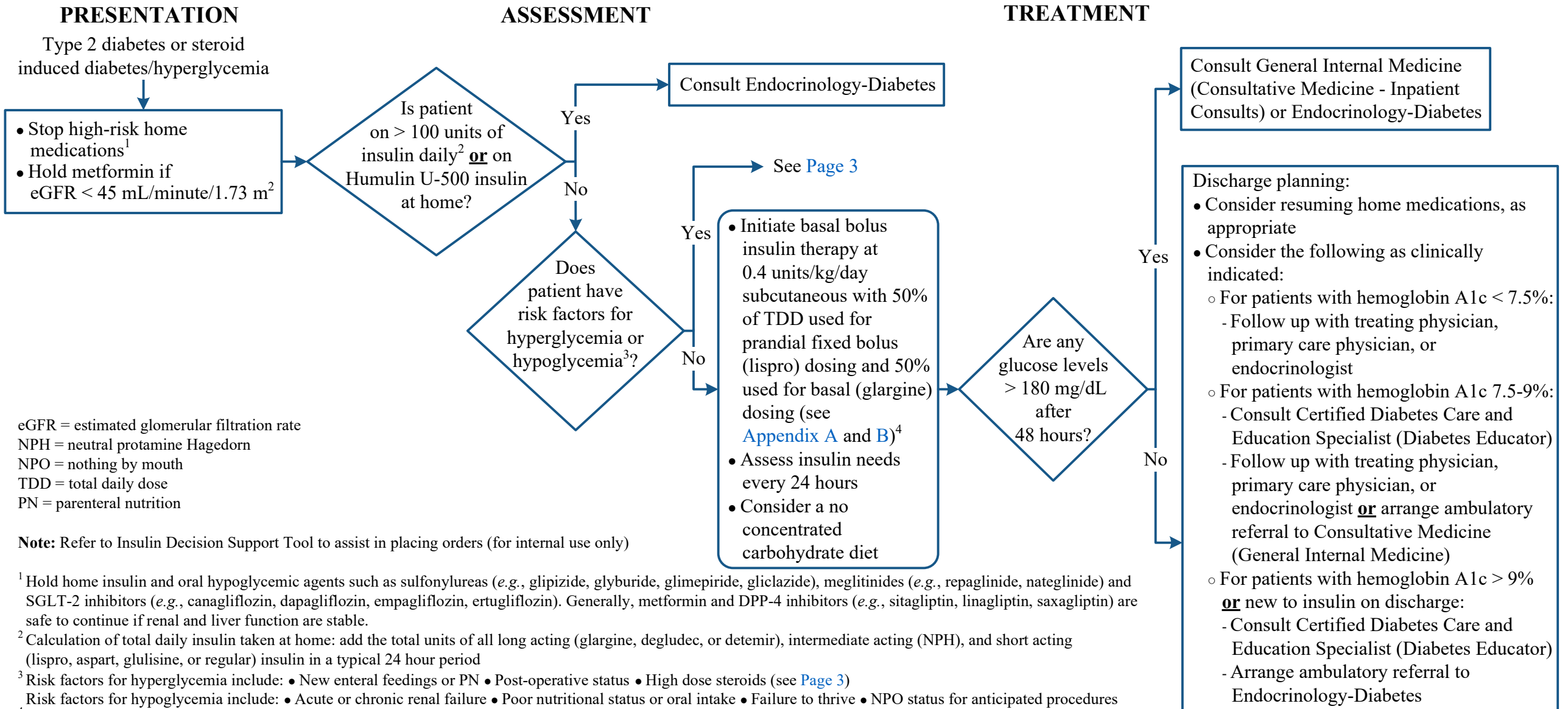
HHS: blood glucose > 600 mg/dL and arterial pH > 7.3 **or** bicarbonate > 15 mEq/L, and minimal ketonuria and ketonemia

EDKA: blood glucose ≤ 250 mg/dL, arterial pH < 7.3, serum bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia

[**Note:** Blood glucose may be lower than expected in patients on SGLT-2 inhibitors (e.g., canagliflozin, dapagliflozin, empagliflozin, ertugliflozin)]

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eGFR = estimated glomerular filtration rate
 NPH = neutral protamine Hagedorn
 NPO = nothing by mouth
 TDD = total daily dose
 PN = parenteral nutrition

Note: Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

¹ Hold home insulin and oral hypoglycemic agents such as sulfonylureas (e.g., glipizide, glyburide, glimepiride, gliclazide), meglitinides (e.g., repaglinide, nateglinide) and SGLT-2 inhibitors (e.g., canagliflozin, dapagliflozin, empagliflozin, ertugliflozin). Generally, metformin and DPP-4 inhibitors (e.g., sitagliptin, linagliptin, saxagliptin) are safe to continue if renal and liver function are stable.

² Calculation of total daily insulin taken at home: add the total units of all long acting (glargine, degludec, or detemir), intermediate acting (NPH), and short acting (lispro, aspart, glulisine, or regular) insulin in a typical 24 hour period

³ Risk factors for hyperglycemia include: • New enteral feedings or PN • Post-operative status • High dose steroids (see [Page 3](#))

Risk factors for hypoglycemia include: • Acute or chronic renal failure • Poor nutritional status or oral intake • Failure to thrive • NPO status for anticipated procedures

⁴ For critically ill patients, refer to IP Critical Care Glycemic Management order set; consider insulin infusion for 2 consecutive glucose levels > 200 mg/dL within 24 hours.

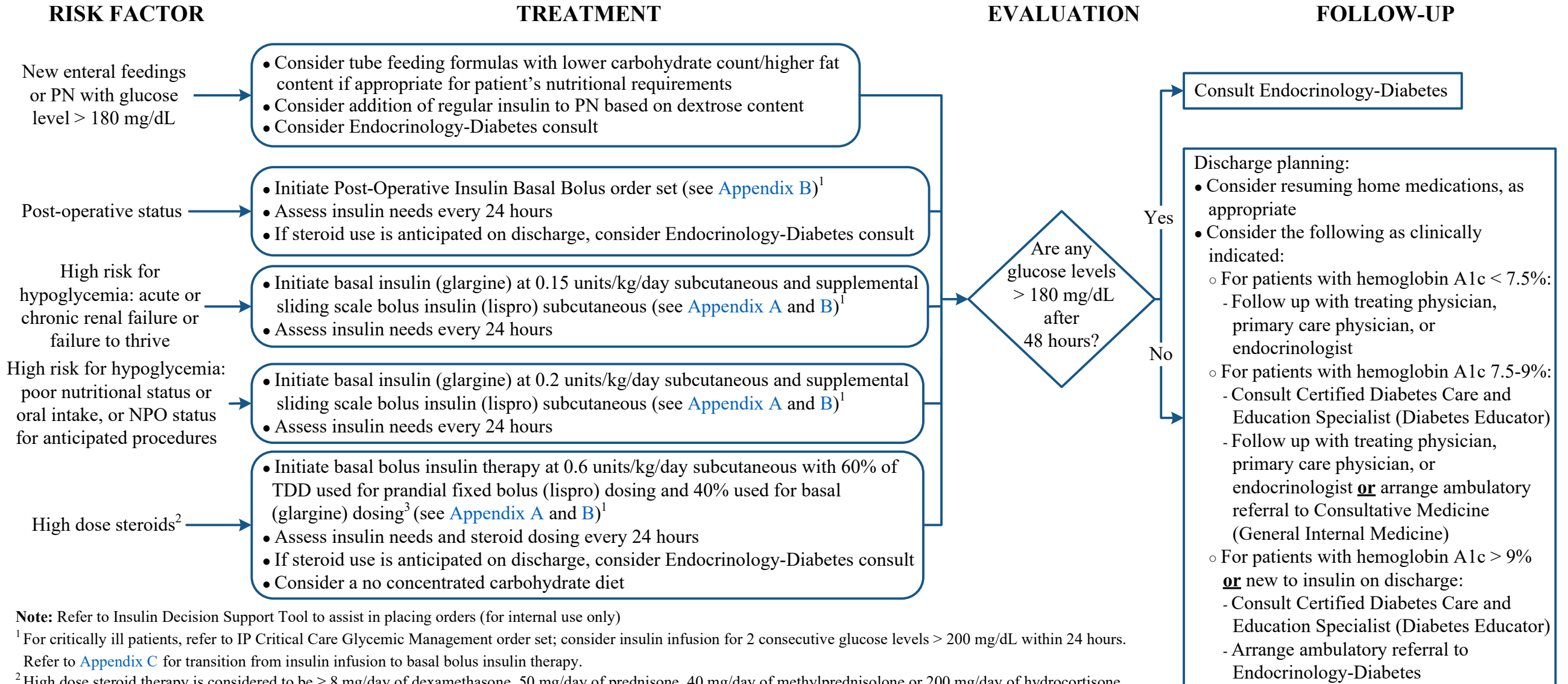
Refer to [Appendix C](#) for transition from insulin infusion to basal bolus insulin therapy.

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TYPE 2 DIABETES OR STEROID INDUCED DIABETES/HYPERGLYCEMIA



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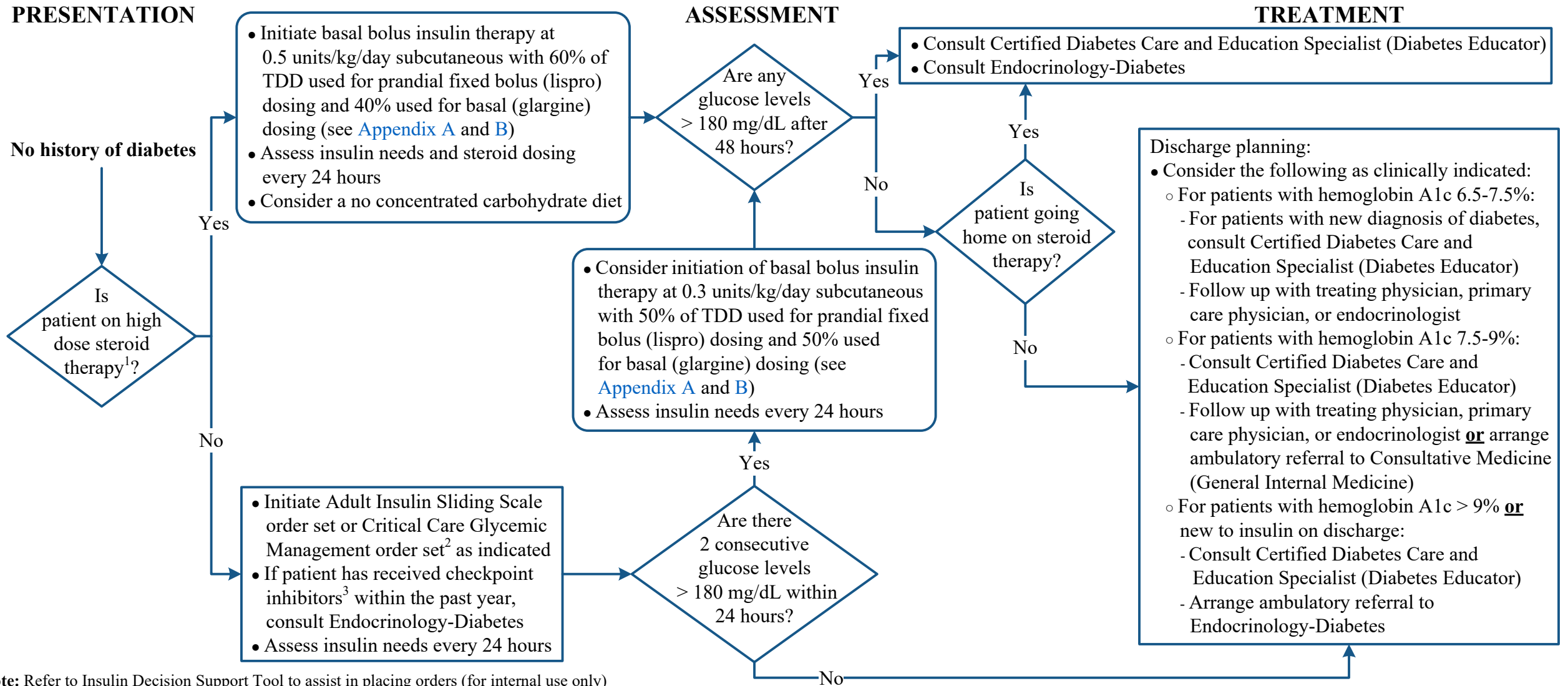
Refer to [Appendix C](#) for transition from insulin infusion to basal bolus insulin therapy.

² High dose steroid therapy is considered to be ≥ 8 mg/day of dexamethasone, 50 mg/day of prednisone, 40 mg/day of methylprednisolone or 200 mg/day of hydrocortisone

³ In recurrent admissions for chemotherapy containing steroids, please review last Endocrinology-Diabetes note for more specific insulin dose recommendations and use as indicated

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Note: Insulin dose adjustments should be made based on the individual patient's glucoses. Refer to the [Hypoglycemia Management algorithm](#), as indicated.



Note: Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

¹ High dose steroid therapy is considered to be ≥ 8 mg of dexamethasone, 50 mg of prednisone, 40 mg of methylprednisolone or 200 mg of hydrocortisone per day

² For critically ill patients, consider insulin infusion for 2 consecutive glucose levels > 200 mg/dL within 24 hours. Refer to [Appendix C](#) for transition from insulin infusion to basal bolus insulin therapy.

³ Checkpoint inhibitors: nivolumab, pembrolizumab, durvalumab, atezolizumab, and related drugs. Patients with recent exposure to checkpoint inhibitors are at risk for DKA and should be evaluated for new onset type 1 diabetes mellitus.

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APPENDIX A: Common Insulin Types and Frequency

Fast Acting Insulin	Dose Frequency
Lispro (Humalog® or Lyumjev® ¹)	Before meals or every 4 hours
Aspart (Novolog® or Fiasp®) ¹	Before meals or every 4 hours
Glulisine (Apidra®) ¹	Before meals or every 4 hours
Regular insulin (Novolin®-R/Humulin®-R)	Before meals or every 6 hours
Long Acting Insulin	
Glargine (Lantus®/Basaglar®/Toujeo®/Semglee®, ¹)	Daily or every 12 hours
Detemir (Levemir®)	Daily or every 12 hours
Degludec (Tresiba®) ¹	Daily
Intermediate Acting Insulin	
NPH (Novolin®-N/Humulin®-N)	Every 12 hours
Mixed Insulin	
70/30, 75/25 ¹ , 50/50 ¹ (mixes of NPH and a fast acting insulin)	Every 12 hours or every 6 hours with continuous tube feedings

¹Not currently on MD Anderson Formulary

APPENDIX B: Basal Bolus Insulin Terms

- **Bolus** insulin refers to a dose of fast acting insulin. This is typically comprised of **prandial** insulin which is scheduled to compensate for the carbohydrate content of a meal and **supplemental** (or sliding scale) insulin to correct hyperglycemia. Bolus insulin is most effective when given before meals, but supplemental insulin alone can be scheduled for patients who are not eating or are high risk for hypoglycemia.
- **Basal** insulin refers to a dose of long acting insulin given 1 or 2 times daily. These insulins absorb slowly to help maintain stable glucose levels.
- **Supplemental** insulin is dosed based on either weight or total daily insulin requirement
- A **basal/bolus** insulin regimen uses both types of insulin to recreate a physiologic pattern of insulin release. This regimen is more effective for most patients than sliding scale supplemental insulin only. Most patients need about half of their insulin as basal and half as bolus. Patients on high doses of steroids will often need more bolus insulin.

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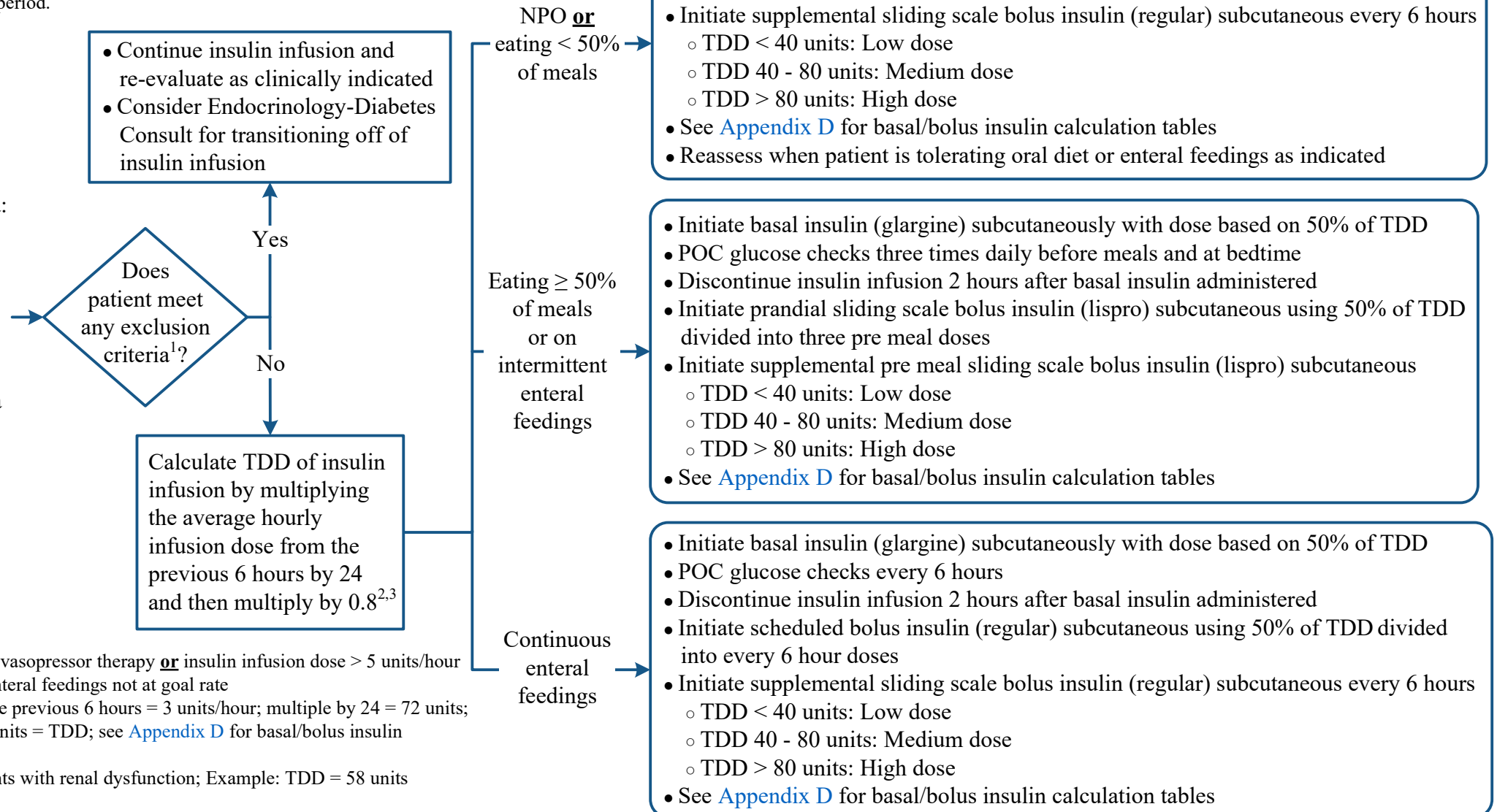
APPENDIX C: ICU Insulin Infusion Transition

Note: This does NOT apply to patients with DKA, EDKA, or HHS

Clinical judgement may supersede exact calculation of total daily dose if patient's clinical status has rapidly changed during transition period.

Patient on ICU insulin infusion **and** meets **ALL** of the following criteria:

- Not in DKA/EDKA/HHS
- Maintained on insulin infusion ≥ 6 hours
- Controlled blood glucose (≥ 3 blood glucoses < 180 mg/dL in past 6 hours)
- Steady insulin infusion doses for a minimum of 6 hours (not varying by > 2 units/hour)



¹ Exclusion criteria includes: Currently receiving vasopressor therapy **or** insulin infusion dose > 5 units/hour **or** steroid dose fluctuating more than 20% **or** enteral feedings not at goal rate

² Example: Average hourly infusion dose from the previous 6 hours = 3 units/hour; multiply by 24 = 72 units; multiply by 0.8 = 57.6 units, rounded up to 58 units = TDD; see [Appendix D](#) for basal/bolus insulin calculation tables

³ Consider decreasing the TDD by 20% for patients with renal dysfunction; Example: TDD = 58 units decreased by 20% = 46 units

Note: After transitioning off of insulin infusion, continue to evaluate glycemic control and adjust management as clinically indicated

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APPENDIX D: Basal/Bolus Insulin Dosing Calculation Tables

- Note:**
- Clinical judgement may supersede exact calculation of total daily dose if patient's clinical status has rapidly changed during transition period
 - Consider dose reduction in patients with renal dysfunction

NPO or Eating < 50% of Meals			
Average Hourly Dose of Insulin Infusion	Dose of Basal Insulin (Glargine)¹	Dose of Prandial (Pre-Meal) Scheduled Short/Rapid Acting	Regular Insulin Supplemental Sliding Scale
Less than or equal to 1unit/hour	9 units once daily	-	Low dose sliding scale every 6 hours
2 units/hour	19 units once daily	-	Low dose sliding scale every 6 hours
3 units/hour	28 units once daily	-	Medium dose sliding scale every 6 hours
4 units/hour	38 units once daily	-	Medium dose sliding scale every 6 hours
5 units/hour	48 units once daily	-	High dose sliding scale every 6 hours

Eating ≥ 50% of Meals or on Intermittent Enteral Feedings			
Average Hourly Dose of Insulin Infusion	Dose of Basal Insulin (Glargine)¹	Dose of Scheduled Prandial (Pre-Meal)² Lispro	Lispro Insulin Supplemental Sliding Scale
Less than or equal to 1unit/hour	9 units once daily	3 units three times daily before meals	Low dose sliding scale three times daily before meals
2 units/hour	19 units once daily	6 units three times daily before meals	Low dose sliding scale three times daily before meals
3 units/hour	28 units once daily	9 units three times daily before meals	Medium dose sliding scale three times daily before meals
4 units/hour	38 units once daily	12 units three times daily before meals	Medium dose sliding scale three times daily before meals
5 units/hour	48 units once daily	16 units three times daily before meals	High dose sliding scale three times daily before meals

¹ Initiate glargine insulin as recommended. For subsequent dosing, hold for glucose < 120 mg/dL.

² Hold for glucose < 100 mg/dL or if NPO

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APPENDIX D: Basal/Bolus Insulin Dosing Calculation Tables - continued

- Note:**
- Clinical judgement may supersede exact calculation of total daily dose if patient's clinical status has rapidly changed during transition period
 - Consider dose reduction in patients with renal dysfunction

Continuous Enteral Feedings			
Average Hourly Dose of Insulin Infusion	Dose of Basal Insulin (Glargine) ¹	Dose of Scheduled Regular Insulin ²	Regular Insulin Supplemental Sliding Scale
Less than or equal to 1 unit/hour	9 units once daily	3 units every 6 hours	Low dose sliding scale every 6 hours
2 units/hour	19 units once daily	4 units every 6 hours	Low dose sliding scale every 6 hours
3 units/hour	28 units once daily	7 units every 6 hours	Medium dose sliding scale every 6 hours
4 units/hour	38 units once daily	9 units every 6 hours	Medium dose sliding scale every 6 hours
5 units/hour	48 units once daily	12 units every 6 hours	High dose sliding scale every 6 hours

¹ Initiate glargine insulin as recommended. For subsequent dosing, hold for glucose < 120 mg/dL.

² Hold for glucose < 100 mg/dL or if enteral feedings interrupted and notify ICU Team

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SUGGESTED READINGS

- Chang, L. L., Umpierrez, G. E., & Inzucchi, S. E. (2022). Management of hyperglycemia in hospitalized, non-critically ill adults. *New England Journal of Medicine*, 387(11), 1040-1042. <https://doi.org/10.1056/NEJMc1de2204691>
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DEVELOPMENT CREDITS

This practice consensus statement is based on majority opinion of the Hyperglycemic Management experts at the University of Texas MD Anderson Cancer Center for the patient population. These experts included:

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